Philip Lelyveld

VR/AR Initiative Program Lead

Entertainment Technology Center,

School of Cinematic Arts,

University of Southern California

PLelyveld@ETCenter.org

[www.etcenter.org](http://www.etcenter.org)

[www.PhilipLelyveld.com](http://www.PhilipLelyveld.com)

Translation by Joyce Liu

Slide 1: I represent the Entertainment Technology Center (ETC@USC) within the School of Cinematic Arts at the University of Southern California. The ETC@USC is funded by the chief technology officers of the six major Hollywood studios plus telecommunications, consumer electronics, and related companies, to advise them on emerging trends and opportunities related to entertainment technology. We are always looking for the next new thing. I have spent the last three years monitoring the evolution of the art, technology, and business of Virtual Reality (VR) and Augmented Reality (AR).

Slide 2: I would like to discuss what the next wave of the internet will be, and what role VR, AR and storytelling will play in it.

Slide 3: I will do this by covering six topics. We will look at some recent patents and products to identify trends. Then I will describe the shape of the industry and where the opportunities are. While I am doing that I will explain and give context to the value of engagement. By engagement I mean the consumer’s emotional involvement in the experience. This leads us to the concept of world building, and the major business opportunities that spring. I will then explain why interoperability matters. Finally, I will discuss how VR and AR impact our personal world view.

Slide 4: Let us start by looking at some recent interesting patents and products

Slide 5: A few months ago Apple announced the Apple AirPod, which are wireless earphones. They also announced that they were eliminating the earphone jack on the iPhone. This angered many consumers. Why would Apple anger their consumers?

Slide 6: There is nothing new about wireless earphones. Motorola was the first to sell Bluetooth headsets for their phones nearly two decades ago. So why did Apple decide to cut the cord now?

Slide 7: Apple does things to transform the world. What do they see coming? What might we see that is a transformational experience? Let’s look at some other technologies.

Slide 8: From the commercial perspective, VR headsets are designed to block out the world around you so they can effectively transport you somewhere else. It could be Mars or it could be the local 7/11, but the intent is to give your brain sensory input from someplace other than where your brain is located. AR headsets project virtual objects and sounds into the world around you. You can see through the glasses, and the virtual objects and sounds are meant to add to, or augment the world around you.

Slide 9: Going beyond this, Apple was recently granted a patent on adaptive projection. The patent describes how images are projected into the room. For example, in this picture, the projector projects text onto the pages of a blank book. The system is also monitoring movement in the room. It will see that the man in the picture wave his arm, and it will highlight the text that he points his finger at.

This idea is not unique to Apple. Disney has a patent on an interactive hotel room environment. A system in the ceiling will project images and sounds into the room to create a fantasy world for the little girl lying in bed. It will also track and respond to her voice and hand motions, creating a truly interactive fantasy experience.

The major theme is that, instead of us reaching out to touch devices, devices will reach out to us to deliver experiences.

Slide 10: Let us add to this sequence the development of social VR, in which many people can interact with each other, through their avatars, in a virtual environment. In an interesting twist on reality, Facebook Oculus recently demonstrated how we could interact with each other in the virtual world, and communicate with the real world through our virtual phones, cameras, and screens.

Slide 11: These things will come together to craft a new world that will deliver the things that we need in the moment that we need them in a form that is most useful to us. This will be a world of personalized blended reality, spatial awareness and full body interactivity, and pervasive connectivity. By pervasive connectivity I mean that we will never be out of contact with our networks and the data streams to us and from us. This world will be dominated by AR technology and experiences because AR allows us to function in both the real and virtual worlds simultaneously, without being isolated from our surroundings. VR will be useful for special situations where its unique properties are the best way to deliver the desired experience.

Slide 12: If we accept that vision as the next wave of technology integration into our lives, what artistic and business opportunities will VR and AR open? How can we accelerate those opportunities?

Slide 13: First let me define how I bundle the VR and AR hardware into groups

Slide 14: There are four distinct VR platforms.

First, there is ‘magic mirror,’ where you hold your cellphone or tablet and either swipe across the screen or wave it around to see into the virtual world.

Second there is cellphone-based VR, in which you insert your phone into a headset and use the phone’s screen and earphones to have an isolating, immersive VR experience.

These two are where the mass market opportunity is now and will be for the foreseeable future, because the cost of entry for the consumer is nearly zero. They already own cellphones and tablets. Much of the content is available at little or no cost. If they have a bad experience, they will not be turned off to VR as a whole because they have invested so little in it, and they will be willing to try it again with some other experience.

Next we have the Head Mounted Displays (HMDs) that have been getting all of the press. These are the higher end personal experience devices that have integrated screens and headphones. They may deliver a seated, standing, or walk-around experience. They may have hand controllers or hand and body tracking technology. These will remain niche market products for some time to come because the cost of entry for the consumer is high, and the consumer understands that there is currently no guarantee that future VR experiences will work on the brand or model of HMD that they buy. I’ll talk more about the importance of interoperability later. Advances in cellphone technology that are designed to support AR capabilities in phones, such as better motion tracking, depth monitoring, and position registration, may also diminish the value of the higher end HMDs in the consumer’s mind.

Finally, there is group or location-based VR. These are the spaces in which virtual worlds are projected onto physical walls and objects. These are also the stand-alone VR experience pods and rides that are appearing in shopping malls and arcades around the world. A lot of money is going into this type of VR experience because it has a clear business model and a relatively clear ROI (return on investment). People are accustomed to paying money to buy a ticket for a location based experience like a movie, concert, or play. This is the next generation of those experiences. Location-based VR is also where most consumers will have their first high-end VR experience, so well executed location-based VR experiences could drive sales of the HMDs as well.

Slide 15: There are two levels of AR platforms.

Weak AR does not try to make the virtual objects blend into the real world. Virtual objects are simply placed in the image as floating, unanchored objects.

Strong AR attempts to have the virtual objects appear as if they belong in the real world on which they are overlain. Within the limits of the technology, they behave as real objects would as you move around them and interactive with them.

Slide 16: Now let me define the new tools, or rather the tools that are most important to the unique nature of VR and AR.

Slide 17: There is the sense of “presence,” the sense that what you are seeing is real. There is a heightened sense of “empathy.” Because there is no frame, such as a TV or movie screen rectangle, separating you from the characters that you are seeing, you have a stronger emotional connection to them. And there is “agency,” the fact that you can interact with the characters and objects in the world, and that the characters and objects in the world will respond to your action. Making use of these tools, including denying them to the consumer, can create powerful experiences.

Slide 18: Much of the conversation around VR and AR focused on the visual aspect of the experience; how wide the FOV (field of view) of the image is, or what the frame or refresh rate of the image is, or what the resolution of the screen is.

Slide 19: But with VR and AR, sound is equally, if not more important than image. We see in front of us, but we can hear all around us. We are able to identify the direction a sound is coming from with an accuracy around three degrees. Sound grounds us in the experience. Spatial audio, which is the ability to place sounds at specific locations around the consumer, should be considered another defining characteristic of the VR and AR experience. It will be critically important as we get thrown into 3D worlds, AR experiences, and social VR experiences.

Slide 20: There are already applications that allow thousands of individuals to take part in the same VR experience, including concerts and parties. Spatial audio makes it possible to comprehend what is going on in these crowded environments because, for example, the voice of the avatar on your right sounds like it is coming from your right, and the voice of the avatar behind you sounds like it is coming from behind you.

Slide 21: Image and audio are key components of the design and management of the user experience. What does the user experience design need to be?

Slide 22: The user experience needs to be designed so that it is natural and intuitive. It should be understandable to the culture of the intended audience without the need for extensive instructions.

Slide 23: In whatever way the user experience design is done, it must be in service of the experience itself. It must support and blend in naturally with the experience you are working to deliver. Because the success of the user experience with determine “engagement.” By engagement I mean how deeply the consumer is emotional involvement in the experience. If they are engaged, they will spend more time in the experience, and return to it over and over again.

Slide 24: Engagement will drive monetization models. This is true for both work experiences like the infinite desktop or AR-enhanced hazardous work tools like the AR scuba goggles in the picture, as well as entertainment and play.

I learned a long time ago that there are only three business models; I pay, you pay, they pay.

I pay; I don’t want to pay, or absorb the cost myself, so you can use the experience that I have developed.

You pay; you pay me to buy or subscribe to the experience that I have developed. You can also pay me for access to special features, to buy virtual goods and tools, and to be part of my community of customers.

They pay; the advertising model. Someone else pays so that you can use the experience that I have developed. They most likely want something from you in return, such as your attention or your personal information.

The more engaged the consumer is, the more likely they are to be interested in trading their money, time, or data for the use of the experience that I developed.

Slide 25: So how will the VR/AR market evolve? People already have cellphones. Why will they buy the expensive VR and AR HMDs?

How did the mobile industry evolve?

Slide 26: Companies gave employees Blackberrys at work as a productivity tool. They took them home, saw they could be useful in the personal life, and the mass market mobile industry was born.

Slide 27: Industries and governments will buy expensive equipment if they solve specific problems. Training and support for their staff. An infinite desktop of spreadsheets and information.

A natural, intuitive user interface will develop quickly because employees will demand it or they will not use the equipment. The developers will motived to improve the user interface quickly so that they can gain both product and market advantage. The entertainment industry will benefit from the lessons learned as these business and industry applications evolve

Slide 28: The consumer market for VR and AR will grow sooner if, in addition to these industrial cases, consumers are exposed to high end experiences at theme parks, arcades, and other venues, and…

Slide 29: there is a dependable supply of good experiences

Slide 30: I was asked earlier what will be the “Super IP?” What will be the next huge market opportunity? One answer may be world-building and the development of engaging AR and VR worlds. We used to talk about stories that contained characters. Now we talk about worlds that contain stories. Worlds are places that consumers, or “visitors”, want to spend time hanging out in. They create their own stories in the space, which helps generate new IP and forms a sustainable business environment for the life of the world. There is nothing new about this idea. For many decades fans have enjoyed dressing up as their favorite characters. We are just adding layers of realism by creating digital worlds.

Slide 31: World building crosses the boundaries between the virtual and the real. Disneyland, McDonalds, and Kim Kardashian’s celebrity universal are all monetizable worlds. Any retail story or restaurant could be turned into a monetizable world.

Slide 32: But you must remain aware that we are working in a constantly and rapidly evolving field in which we are developing the technology and the experiences at the same time. They inform and inspire each other.

Slide 33: One consequence of this constant innovation is a lack of interoperability among devices, APIs (application protocol interfaces) and code, which will slow consumer adoption. Interoperability is the ability of devices or software to communicate with each other, exchange data, and appropriately use the data that has been exchanged. As I mentioned earlier (slide 14), the consumer understands that there is currently no guarantee that future VR experiences will work on whichever HMD that they buy.

Slide 34: A path to success in these early days is to focus on identifying what can be open and interoperable, versus what must be unique to create competitive advantage.

Slide 35: With all of these platforms, and the hundreds of products within each platform, coming on the market, the only way to serve a large group of them and give the consumer comfort when they go to buy them is to work towards some baseline of an open and interoperable ecosystem. I am not saying that every device needs to be limited to the same features, or that all code can only have a standard set of capabilities.

Slide 36: There are many groups, consortia, and standards bodies around the world looking into what could be VR and AR standards. I am advocating for a slightly different path. I am asking people to start thinking about what is fundamental to a successful VR or AR experience on each of the platforms that I defined earlier (slides 14, 15). If we can agree on how to describe those fundamental experiences, then we can define them as the basis for interoperability, provide some stability to the industry, and encourage innovation on top of them.

Slide 37: This is not a new concept. When the motion picture industry came together to convert movie theatres from using film to using digital projectors, there were many digital projector manufacturers in the marketplace and no standard file formats. We convened a small group of key digital project manufacturers, data server manufacturers, movie directors, and other key people in the movie creation and distribution workflow. We asked them to identify what fundamental aspect of the technology behind the movie theatre experience was;

1) necessary for a good consumer experience

2) did not impact competitive advantage

3) would help build the market for everyone

The group identified characteristics of the image on the screen; minimum brightness, frame rate, color depth, and a few others. The group said that as long as a technology met those minimum experience guidelines, the Hollywood studios would allow their movies to be projected using the technology. The guidelines were made public so every competitor in the marketplace to build to them. They were sent to standards bodies so that as the industry adopted them they slowly became official industry standards. It was known from the beginning that competitors would work to exceed them to gain competitive advantage, so they were designed to evolve and improve as time went on.

This is a model that the AR and VR industry could try. And it is important to try it soon.

Slide 38: The reason we need interoperability soon is that we are about to get a flood of new input and output devices. We are still thinking about VR and AR through the lens of past technologies; movies, video games, social media, etc. But it is starting to reveal whole new possibilities, and the industry will benefit from baseline interoperability that can accommodate them.

Slide 39: Necklaces and collars that emit smells via Bluetooth commands are coming on the market. Samsung is already showing a VR headset with “Galvanic Vestibular Stimulation” (GVS). GVS sends small electrical signals to your inner ear so you feel as if you are moving when you are not. There is a company in Los Angeles currently selling virtual food packs to be used with your VR headset. They claim that taste is 80% smell, so they sell you a collection of smells and a chewable plastic cube. One of the most interesting is the effort by some groups to use data from individual organs in your body as VR experience tools. A group in the UK placed heart monitors on 17 subjects, and put them into a VR experience with an avatar body lying on a table two meters in front of them. When the researchers projected each subject’s heartbeat into the avatar using spatial audio, within 2 to 3 minutes most of the subjects reported having an out-of-body experience. They said that they felt as if they were the avatar, but their spirit was floating around the room looking down on their avatar body.

Slide 40: There is so much we do not yet know about the what VR and AR can deliver. We need to enable an industry with sustainable business models that will support research and constant innovation.

Slide 41: Where is this all going?

Slide 42: We are erasing the boundaries between real and virtual worlds for both work and play.

Slide 43: A well-crafted VR experience rewires our brain just like a real experience.

Slide 44: We are redefining “reality.” With AR, VR, constant connectivity, and the flow of data, sounds, images, and other sensory experiences to us and from us, it is no longer going to be clear where “I” begin and end.

How do I know what only I experience, versus what the people around me are seeing and experiencing with me?

Slide 45: The culture is ready for VR and AR. We already carry around the technology needed to make it possible.

Slide 46: But we must always remember; consumers do not buy technologies, they buy the experiences that the technology delivers.

Slide 47: So we should all continue to be creative and innovation. Let us all make money. But please consider the ramifications of what you create on individuals and society as a whole.

Slide 48: Thank you.